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MINISTRY OF PUBLIC BUILDING AND WORKS

PRODUCTION OF BUILDING COMPONENTS IN SHIPYARDS

Report to
the Minister of Public Building and Works

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To The Minister of Public Building and Works
Lambeth Bridge House
London, S.E.1

Sir,

On 31st December, 1962, you asked us to study and report by 28th February, 1963, on the feasibility of spare capacity in shipyards being devoted to the manufacture of building products. This rapid enquiry was to be a technical one; first to establish which types of components or systems are most needed, and second to ascertain which of these could readily be manufactured in shipyards, giving particular attention to cost levels.

We now present our report.

We would like to acknowledge here the enthusiastic co-operation we have received generally from the industry and from public bodies from whom we have sought information.

We are, Sir, your obedient servants,
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SUMMARY

(Figures in brackets indicate the relevant paragraphs in the body of the Report.)

1. **Survey**

(*a*) A sample of eleven yards has been visited representing roughly one third of the productive capacity of the industry in the United Kingdom. (10 – 16)

(*b*) In addition a rapid assessment has been made of likely demand. (17 – 20)

2. **Relevant Characteristics of Shipyards**

(*a*) Managements are enthusiastic for such diversification. (23)

(*b*) Prefabrication is an established method of efficient shipbuilding, and yards have large production spaces with good cranage for this purpose. (24 – 25)

(*c*) Shipyards represent the concentration of a wide variety of skills and production capacities. (26)

(*d*) As a result of modernisation many yards have spare production space even when working to capacity. (30)

(*e*) Almost all yards are well sited in relation to road, rail and sea transport. (31)

3. **Existing Diversification**

(*a*) One yard visited was collaborating with a local authority for the production of mobile homes for use in redevelopment areas. (33)

(*b*) Two yards visited were economically successful in minor diversification particularly steelwork and joinery products for the building industry. (34 – 36)

(*c*) A further yard had, since the last war, turned over successfully from ship repairing to the manufacture of products for the building industry. A separate firm was formed for the new outlet, and the change over was a gradual process. (37 – 38)

4. **Spare Capacity**

(*a*) From our sample, we estimate that the shipbuilding industry has roughly 10½ million square feet of covered production space. (42 – 43)

(*b*) If five per cent. of this space were turned over to the production of industrialised housing, we estimate that this could provide components to make some 30,000 dwellings a year, or components to make an equivalent amount of other building. (44)

(*c*) The labour force currently employed in shipbuilding is seventy per cent. of its strength two years ago. This percentage is likely to drop later this year. In the yards visited, the figure has in fact already dropped to fifty per cent. (46)

(*d*) Managements foresee no difficulty in recruiting labour for diversification into industrialised building. (47)

(*e*) Information on manufacturing costs we received, including notional quotations for building products, suggests that many yards could supply the building industry at competitive prices. (49–55)

5. Likely Products

(*a*) Yards could supply two types of components, conventional products similar to those already supplied to the building industry, and new products or complete systems of construction for industrialised building. (57)

(*b*) In the growing field of industrialised building there are two types of products which the yards might supply, heavyweight components or systems, such as precast concrete units, and lightweight components for lightweight prefabrication. (64–71)

(*c*) Our enquiries suggest that the outlet for conventional products is likely to be limited, because the market is already highly competitive. (59–60)

(*d*) Information from existing manufacturers of heavyweight systems on the Continent suggest that these are likely to provide only a limited outlet, because of the high transport costs involved in delivering to sites well away from shipyards. (64–67)

(*e*) Lightweight components or systems of construction on the other hand could be supplied throughout the country and might even be exported at a later stage. Such systems usually consist of light frames in steel or concrete, assembled out of standard components, onto which are mounted further factory-made units in a wide variety of materials to form roofs, upper floors, external walls and windows, partitions and ceilings. They have already been successfully developed in this country, chiefly for the schools programme, and do not require expensive site plant for erection. (71–75)

(*f*) In comparison with heavyweight prefabrication they are likely to require less capital investment in plant, and less time to get into production, especially if developed to exploit the shipyards' existing productive capacity. (74)

(*g*) The manufacture of complex service cores for dwellings or other building types would be possible in shipyards, because of the multiple skills available. (63)

6. Methods of Diversification

(*a*) We visualise four ways in which the yards might supply products to the building industry:—

(i) Tender for conventional products, which could probably only marginally employ available spare capacity. (80–81)

(ii) Associate with existing manufacturers so that they could receive suitable advice on design, production, price levels and marketing. (82–83)

(iii) Rent space to manufacturers who would then supply direct to the building industry. (84–86)

(iv) Develop new components or systems of construction. Yards at present lack the necessary technical knowledge and experience to undertake such work. (87–89) (*b*) It would seem essential to warn yards of the danger of attempting to enter the entirely new field of industrialised building unilaterally. Previous attempts to diversify have often been unsuccessful because of failures in design, price level or marketing. (94)

7. **Large-scale diversification**

(*a*) Diversification on a large scale would appear possible if two basic needs are met; first, that there are sufficiently large bulk orders; and second, that the necessary professional and technical expertise is available. (95–97)

(*b*) Such large scale diversification could add to the productive capacity of the existing component manufacturing section of the building industry, but is only likely to result from increased demand. (98)

(*c*) In the housing field, the grouping of more local authorities into consortia will lead to more bulk orders. Consortia of local authorities, New Towns and housing associations in shipbuilding areas might have a special interest in relating their work to the potential capacity of shipyards so as to alleviate the unemployment problem. (99)

(*d*) The design of suitable components or systems of construction would best be tackled by development teams, each consisting of a group of architects, engineers, quantity surveyors and administrators working together, and each related to a large, long-term programme of building. Such teams could collaborate with yards to ensure that the best use is made of their existing productive capacity. (100)

(*e*) Other outlets could be developed along the same lines to a lesser extent, and particular attention could be paid to the schools, university and hospital programmes. (101–102)

8. **Conclusions**

(*a*) Shipyards can offer spare capacity which is suitable for the manufacture of components or complete systems of industrialised building. (103)

(*b*) There could be some diversification into the manufacture of conventional products but we believe that this could only be on a minor scale. (104)

(*c*) If industrialised building is to be introduced into this country on a large scale then considerable factory space is required. It would be preferable to use such space already available in shipyards rather than to set up new factories. (105)

(*d*) The best method for such large-scale diversification lies in the coordination of building into large-scale programmes, especially in the housing sector. Development teams could invite the collaboration of shipyards in the design and production of components and systems of construction for use in such programmes. (106)

(*e*) Local authorities in shipbuilding areas might have a special interest in pooling their building programmes. We understand that the Government is taking the initiative in encouraging further local authorities to pool their programmes for housing, schools and other building types and, where appropriate, to set up development teams. (107)

(*f*) Managements are clearly enthusiastic for such diversification, but need technical guidance. Development teams would be the best means of providing this. (108)

(*g*) The best form of industrialised building is likely to be lightweight components and systems of construction, especially since these could be transported relatively cheaply to sites outside the shipbuilding areas. (109)

(*h*) Such measures could not only be the basis for permanent diversification of shipyards but could make a significant contribution to increasing the output of the building industry and to improving standards of quality. (110)

METHOD OF ENQUIRY

9. During the eight weeks from the setting up of the enquiry to the completion of this report, our main work has been to examine a representative sample of the shipbuilding industry throughout the United Kingdom. In terms of productive capacity, this sample represents roughly one third of the whole industry. We considered it desirable also to examine briefly the likely demands for new building such as houses, hospitals, and schools particularly in the areas where shipyards are concentrated, and to make a token comparison with the production facilities of industries already manufacturing components for building.

Shipyards

10. On the advice of the Ministry of Transport, and in view of the limited time available, we have concentrated our study of the shipbuilding industry on two areas, the North-East coast of England, and Central Scotland.

11. We have visited eleven yards in these areas, where we have received the fullest co-operation from managements in assessing the broad characteristics of their productive capacity.

12. The factual information we have sought from individual yards has included areas of covered production space available and sizes of labour forces including breakdowns into the main trades.

13. In some cases we have also sought information on typical wage rates of the various trades, on the make-up and amount of overheads, and the rough level of profit at which yards would hope to operate should they diversify.

14. As a further step to testing whether it would be possible economically for shipyards to supply products to the building industry, we have asked some yards to provide quotations for bulk orders of a limited range of products similar to those at present in use for industrialised building.

15. We found that a number of yards visited had in a very minor way undertaken work for the building industry, chiefly the supply of high quality

joinery. Three of the yards visited, however, had attempted to diversify more vigorously, in one case as far as about a third of the firm's total productive capacity.

16. We also visited a yard, previously engaged on ship repairing, which since the last war had completely turned over to the manufacture of products for the building industry.

Assessment of Demand

17. We considered it desirable in parallel with this sampling of the shipbuilding industry, to examine briefly the likely demand for new building, mainly in the public sector and covering such building types as housing, schools, hospitals, particularly with reference to the shipbuilding areas we visited.

18. We have received information from the Ministry of Housing and Local Government and the Ministry of Education on the current building programmes in North-East England in their respective fields.

19. We have received the full co-operation of the Scottish Development Department in assessing the equivalent programmes in Scotland, together with its forecast of the likely future role in them of industrialised building. We have also discussed with the Scottish Special Housing Association its current building programme.

20. In addition, we have reviewed the general range of products at present supplied to the building industry, to assess which fields might be most suitable for shipyards to enter.

Existing Suppliers

21. We also considered it desirable to make a token comparison of production space, labour and equipment by visiting factories abroad already supplying components for industrialised housing. We have at the same time sought the views of one of the larger building contracting organisations in this country.

RELEVANT CHARACTERISTICS OF SHIPYARDS

22. A number of characteristics emerge from our survey which are common to the majority if not to all the yards visited, and which appear relevant to the objectives of our enquiry.

23. We found that managements are generally enthusiastic for the building industry to become an alternative outlet for the productive capacity of their yards. In many cases managements express willingness for this to be on a permanent basis for at least part of their output, even though this might require investment in new plant, the development of new skills, and possible difficulties in redeploying labour. Others are equally prepared to face such problems, but regard such diversification as a way of continuing to gain a return on capital invested and of holding together the skilled labour force on which the industry depends until such time as they can return to full-scale shipbuilding. With some managements, we surveyed other directions in which they might diversify, but found no positive signs that any such alternative outlets exist on a worthwhile scale.

24. Bearing in mind the purpose of our enquiry, the most important feature which emerges is that prefabrication is a technique already fully established in the shipbuilding industry. The advantages are universally recognised of carrying out as much of the work as possible under cover in workshops, rather than in the open on the slipways, or in ships being fitted out after launching. As a result, the prefabrication of large assemblies in steel plate is general practice, as well as plumbing and cabin furniture in smaller units. Some yards are in process of extending this technique to include the internal wall and ceiling linings of cabins. In one or two cases, yards are intending in the future to assemble superstructures in their workshops either as single units or in sections, complete with all internal finishes and services.

25. To meet the needs of such methods in nearly every yard visited there are large covered production areas with good cranage, as well as suitable facilities for the handling of steel plate on arrival, and large cranes for transferring heavy built-up units from the production sheds to the berths.

26. The main bulk of output is the cutting and welding of steel plate, but beyond this the shipyards represent the concentration of a wide variety of skills and productive capacities. The exact nature of such ancillaries varies from yard to yard, but generally includes joinery, plumbing, electrics, blacksmiths' work and painting. Larger yards tend to have large and more comprehensive facilities, in some cases including workshops for sheet metal work, castings and ships engine manufacture. The scope also varies with the class of ship which the yard normally builds, passenger ships for instance requiring a higher content of joinery than other types. On the other hand some work is normally subcontracted to specialist firms, typical items being air conditioning and insulation.

27. Where comparisons can be made, we were impressed that the shipyards are geared to a higher standard of quality than is normal in the building industry.

28. Because of the form in which ships are designed, especially the curves of camber and sheer in decks, shipyards are geared to continual variations in the size and shape of components, as opposed to the bulk production of repetitive items. There are, however, signs of a move towards a form of ship design which can exploit at least a measure of standardisation.

29. The yards often have extensive design and drawing office facilities, because it is normal practice for ship owners to ask for tenders, usually within a comparatively short time limit, in which the design is largely the responsibility of the shipbuilders concerned.

30. Mechanised methods introduced in recent years, especially the automatic flame cutting of plate by electronically controlled machines, have resulted in a saving in production space and labour. As a result in some yards there is covered production space which is now redundant, even when they are working to full capacity.

31. Almost all yards are well sited in relation to road, rail and sea transport.

EXISTING DIVERSIFICATION

32. Three yards were visited which have vigorously pursued a policy of diversification, mainly into the building field.

33. One of these yards was collaborating with a local authority in the design and manufacture of mobile houses, for temporary use on redevelopment sites.

34. The other two yards had received orders after competitive tendering, mainly for structural steelwork and joinery, and also such steel products as bridgework and concrete shuttering. In one yard, this work has occupied up to about a quarter of its total productive capacity.

35. Both yards had been economically successful in this venture. Both had mechanised methods of recording in detail the costs of each job separately and this appeared relevant to their ability to underbid established manufacturers of such products on a profitable basis.

36. Both yards found that trade union disputes could be avoided if the shipyard labour was not used on building sites.

37. One further yard was visited which had completely turned over since the last war from ship repairing to light engineering, manufacturing products for the building industry.

38. This involved:

    (*a*) a completely separate company created for the purpose, in terms of management, finance, productive space, plant and labour.

    (*b*) Management and sales staff being recruited largely from outside the shipbuilding industry.

    (*c*) ship repairing and the light engineering carrying on side by side for about fifteen years, before the ship repairing was completely shut down, allowing a gradual reduction of shipyard labour.

ASSESSMENT OF CAPACITY

Spare Production Space

39. The yards visited were working on average to roughly half of their potential capacity, and some yards had virtually no work under construction at all.

40. Almost all shipyards have modernised considerably over the last ten years both in terms of machinery and layout, and have thus succeeded in saving space even when working to full capacity.

41. As a result, covered areas with good cranage facilities are available in nearly all yards.

42. The yards we visited had a total of 3½ million square feet of covered production space, of which 2½ million square feet had overhead cranes. The yards also had a further 3 million square feet of open storage areas with overhead cranes.

43. Since the yards we visited represent about one third of the total productive capacity of the industry in the United Kingdom, we estimate that the total area of covered production space in all yards is about 10½ million square feet.

44. If five per cent. of this covered space could be turned over to the manufacture of industrialised housing, we estimate that on a one-shift basis it could produce components to make some 30,000 dwellings a year or components to make an equivalent quantity of other building. This estimate is based on the current output of factories already in this field.

45. We estimate that the total area of open storage areas with overhead cranes in all shipyards is about 9 million square feet. A proportion of this area might, however, be uneconomic to use for some purposes, where there are cranes originally installed to carry very heavy loads.

Spare Labour Force

46. Another measure of capacity in shipbuilding is the fact that the current labour force in all yards is at present roughly 70 per cent. of what it was two years ago. This percentage is likely to drop later this year. In the yards we visited, the figure has in fact already dropped to about 50 per cent.

47. We understand that some tradesmen who have skills suitable for the building or other industries, for instance joiners, have already diversified into these fields where possible. Managements we interviewed, however, foresaw no difficulty in recruiting sufficient labour for diversifying into industrialised building.

48. Such activities would probably demand a smaller total labour content, and a smaller content of skilled labour than is required for shipbuilding. A trend in this direction is in any case observable in the shipbuilding industry itself.

Labour Rates

49. The basic time rates in the shipbuilding industry appear to be slightly less than for the same classes of labour engaged in the building industry (e.g. joiners, plumbers, painters).

50. An examination of the wage structure of the firms visited indicated that the "take home" wage is always in excess of the basic time rate. The amount of this addition, however, varies from yard to yard, and the greatest differential occurs in the heavy metal trades. It is in these latter trades where the highest element of the shipbuilding labour strength is employed, and therefore the most likely to be affected by any diversification.

51. The limited amount of work undertaken by yards in fields other than shipbuilding about which we have been informed has always been undertaken at a profit and at shipyard labour rates. As far as possible we understand that yards would prefer to continue on this basis, in order to keep their existing labour structure in being in the hope that shipbuilding will revive.

Economic Feasibility of Yards to Compete

52. Some yards visited were asked to quote for hypothetical orders of building components. It was decided that this could best be achieved by selecting items similar to those already used in industrialised building, so that the quotations could be related to current competitive prices obtained for an actual building programme.

53. Two main items were selected, one being wood windows, the other steel lattice beams, and in each case yards were asked to assume that these were in the form of bulk orders.

54. An appraisal of the prices received, summarised in the table at the end of this section, is as follows:—

Wood Windows – These varied from 58 per cent. below to 27 per cent. above the current price, the majority of quotations being below. This suggests that as far as this particular window is concerned, joinery departments of the shipyards could compete in this field on a competitive basis.

Steel Beams – This exercise was divided into two parts. In the first, yards were asked to state a price for the manufacture of a beam to a specified design. In the second, yards were given the necessary data upon which they could design a beam performing the same function as the beam in Part I and within the same overall size but the price of which was to reflect the best use of their particular plant and skills.

Part I – Price Assessment for a beam of a given design

The prices in this field varied between 133 per cent. above to 32 per cent. below the current price. The majority of the prices received, however, indicates that the yards can offer this type of work at competitive prices.

Part II – Price Assessment of beam of the shipyard's own design

Here again the diversity of quotations received varied between 64 per cent. above to 26 per cent. below the price of a similar beam currently supplied as an alternative to the one selected for Part I.

55. Despite the wide divergency of quotations received, which may be due in part to the speed at which the exercises had to be undertaken, the majority of firms submitted quotations which can be considered as competitive. We are of the opinion that in the case of light steelwork a yard would need to be certain of at least £150,000 – £200,000 of work per year over several years to make it an economical venture.

56. These notional quotations because of the small range of the components taken, cannot be regarded as precise information covering the shipbuilding industry as a whole. They suggest, however, that many yards could supply the building industry at competitive prices in present conditions.

Quotations Received Expressed as a Percentage of Typical Current Market Prices

Wood Window	Steel Beam Part I	Steel Beam Part II
per cent.	per cent.	per cent.
42	68	74
60	70	78
84	73	84
98	82	84
104	87	119
107	109	127
	233	164

SURVEY OF LIKELY PRODUCTS

57. There are two main types of products we visualise shipyards might supply to the building industry.

Conventional Products

58. First, there is a limited range of conventional products, already on the market, which might suit the existing productive capacity of shipyards. Dominant among these are various types of structural steelwork and joinery. Such fields are already highly competitive and the industries involved are not at present working to full capacity, especially in the case of steelwork. It would thus seem unlikely that they can offer an immediate large scale solution to the unemployment problem.

59. Such outlets are not necessarily ideally suited to the present productive capacity of the shipbuilding industry. For instance, fabricated steel for building tends to be considerably lighter than the steel plate to which the shipyards are accustomed. Again, shipyard joinery is to a higher quality than is normally supplied by joinery works to the housing programme. It is also in the form of individual items or limited batches rather than mass production of standard items.

60. However, with the expansion of the building programmes of such building types as hospitals, universities and teacher training colleges, there is likely to be an increasing demand for high quality joinery, for such items as laboratory benching and fitted furniture. Although the joinery shops in some shipyards are relatively small, the total productive capacity of the shipbuilding areas in this field is large, and might well be diverted in this direction.

New Components and Systems

61. Second, there is the growing demand for components or complete systems of construction required for industrialised building.

62. The fact that the shipbuilding industry for its own purposes has adopted prefabrication techniques, and that covered space with good cranage is generally available, suggests that this field would be suitable as far as their existing buildings are concerned.

63. Since the normal labour force of shipyards covers a wide field of different trades, they would be well equipped to prefabricate relatively complex units. These might include complete plumbing or electrical assemblies. They might also prefabricate service cores for housing, consisting of bathroom, w.c. and kitchen together with all the heating, plumbing and waste installations for the individual dwelling, a product which is already well established abroad. Similar units might also be developed for other types of building, such as bathrooms for hotels, or service cores for hospitals, although the demand for such units would be smaller.

Heavyweight Prefabrication

64. Because shipyards are almost all well sited in relation to road, rail and sea transport, and can offer covered production space with overhead cranes, they would appear suitable for the manufacture of large and heavy precast concrete units, mainly for use in housing. This is a technique which is well

established on the Continent, but which has not yet been brought into use on any significant scale in Britain, although we understand that a number of the larger contracting organisations in this country have taken out licenses from Continental manufacturers.

65. We understand that the cost of transporting these large and heavy precast concrete units is likely to limit the economic use of such systems to areas within about fifty to a hundred miles of the factory. This would appear to limit the wide adoption of such systems by yards, as the shipbuilding industry tends to be concentrated in certain specific areas.

66. There are, it is true, areas adjacent to shipyards where the demand for housing is high. A typical case is the Clyde region and an officially appointed technical study group have estimated that the housing programme in this area could absorb about 3,000 heavyweight prefabricated dwellings a year.

67. We understand from the managements of heavyweight prefabrication factories on the Continent that an individual production unit must produce at a rate of at least 1,000 dwellings a year over several years in order to be economic. This suggests that such an outlet could only absorb the spare capacity of a small number of yards in each shipbuilding area.

68. Nevertheless, we were informed by some managements of the yards we visited that they foresaw no special difficulties in turning over to the fabrication of precast concrete units, provided that they had the necessary design and technical advice. Some yards, for instance, have tended in recent years to use their own labour for the civil engineering work involved in modernising their layouts, including reinforced concrete walls for berths and concrete piling.

69. Many yards can offer covered space suitable for heavyweight prefabrication, and this might thus be an immediate outlet for a small number of yards, presumably if they collaborated with the licensees of some of the Continental systems. We understand that £500,000 might be a typical figure for the capital investment required for a factory to manufacture one of these systems, including plant, and that roughly 20 per cent. of this might be saved if production could be set up in suitable existing buildings.

70. We are not satisfied, however, that the demand from local authorities is yet sufficiently co-ordinated to make the mass production of such systems economically possible. Nor are we satisfied from the limited tour we made on the Continent of housing produced by this method that such systems can be manufactured on any scale in this country until they have been examined in detail and if necessary modified to suit the housing and byelaw needs of this country.

Lightweight Prefabrication

71. A further outlet would be the manufacture of components or complete systems built up of lightweight components, as far as possible avoiding wet processes on site. Such systems usually consist of light frames in steel or concrete, assembled out of standard components, onto which are mounted further factory-made units in a wide variety of materials to form roofs, upper floors, external walls and windows, partitions and

ceilings. They have been successfully developed in this country, especially for the schools programmes, and it is possible to develop such systems for use in housing.

72. One advantage of such systems and the components supplied for them would be that the limitation on output imposed by transport costs in the case of heavyweight prefabricated units would no longer apply. As an instance of this, steelwork components are supplied from Clydebank for the Consortium of Local Authorities Special Programme of which Local Authorities in various parts of Great Britain are members.

73. Another advantage is that there is already experience in this country in the use of such systems. From a technical point of view this would favour their further development.

74. Such systems do not demand expensive or elaborate site plant, and can therefore be erected by small and medium sized contractors, as well as by the large national organisations. This is in contrast with the heavyweight systems, which tend to demand expensive plant beyond the scope of the average builder. Lightweight systems would also require considerably less capital investment and less time to get into production. This would be particularly so if components or systems could be designed specifically to exploit the shipyards' existing productive capacity. Lightweight systems therefore appear to offer greater scope for exploitation than heavyweight systems.

75. Bearing in mind the interest shown abroad in British lightweight systems in both steel and concrete frames, and the siting of shipyards in relation to sea transport, it is not impossible to visualise the export of such components or complete systems. But this would presumably only be possible as an extension of large-scale production for the United Kingdom.

Rationalised Traditional Construction

76. A further method of building which may be developed is to rationalise traditional construction by a combination of conventional materials, such as load-bearing brickwork or in situ concrete, and lightweight prefabricated components such as external wall panels, roof decks and internal partitions.

77. Should such methods be developed on any scale, the lightweight components involved could form a suitable outlet for shipyards, and would offer the same advantage as those already discussed in relation to lightweight prefabrication.

78. There would also be scope, particularly in relation to housing, for the types of service cores or room assemblies already mentioned.

POSSIBLE METHODS OF DIVERSIFICATION

79. We have reviewed the various methods yards might adopt in seeking outlets in the building industry.

Conventional Products

80. Yards might compete for conventional products at present supplied to the building industry, especially in the form of structural steelwork and joinery. Potentially, this offers an immediate solution to the problem of

diversification, but the yards would be in competition with existing firms in these fields, and we therefore suggest that at present it can only marginally employ the surplus capacity available.

81. The long term demand for certain products is likely to increase, however, especially in the field of high quality joinery for the expanding programme of hospitals, schools and other building types.

Association with Existing Industry

82. Another method yards might adopt would be to associate with existing manufacturers or contracting organisations for the supply of products or complete systems of construction. This might be carried out in a variety of ways, such as the formation of a joint subsidiary company for the purpose, or by manufacture under licence.

83. The advantage of such a method would be that the yard could receive any technical assistance required, and this might range from questions of design and production to sales.

Renting Production Space

84. Almost all yards visited during our survey had spare production space, usually with good cranage, and this might be rented to manufacturers already established in the building field, or to contractors wishing to set up factories for producing components.

85. Such a method would minimise the problems involved in diversification, in such fields as labour turnover, design, production and sales.

86. The space available in shipyards might attract manufacturers since rents would presumably be lower than the equivalent cost of new factories.

New Products and Systems of Construction

87. In time, yards might also develop their own components or systems of construction.

88. Potentially this method is likely to be the most fruitful, since it would appear to be the best way in which the existing productive capacity and multiple skills of the yards could be exploited to the fullest advantage.

89. On the other hand such a method offers the severest challenge to shipyards in terms of design, price, and marketing. Such problems could, however, be minimised by the collaboration of yards with the development teams of such bodies as consortia of local authorities or New Towns for the joint development of components or complete systems of construction.

Policy of Management

90. Detailed questions of policy for the managements of shipyards which diversify are beyond the scope of our survey, and might well be studied later. But the discussions we have had with yards which have been successful in finding an alternative outlet in the building industry suggest one or two lines of guidance.

91. Yards would appear to be in a sounder position to diversify successfully where they form separate subsidiaries specifically for the purpose, with their own management, labour and plant. Such a step would appear more relevant in the larger shipyards.

92. The information yards have about shipbuilding costs will not be of any great value to them in the building field, and for this reason it would appear desirable for accurate and detailed records to be kept of expenditure on labour, materials and overheads for each order, as a basis for future estimates.

93. Where appropriate the yard would need to employ key staff skilled in the particular field, especially on the management, design and sales sides.

94. In addition it would seem essential to warn yards of the dangers of attempting to enter a new and unfamiliar field such as industrialised building unilaterally. For instance, examples were pointed out to us during the survey of unsuccessful attempts by yards to diversify into other fields. The main dangers would appear to be failures to achieve suitable designs, the right price level and adequate sales organisation.

LARGE SCALE DIVERSIFICATION

95. Diversification of the yards into the production of industrialised building components on a large scale would appear possible provided that two basic needs can be met.

96. The first is that there are sufficiently large scale bulk orders for standard components or complete systems of construction.

97. The second is that the necessary professional and technical expertise is available to relate the productive capacity of the shipyards to the requirements of users of such systems or components.

98. We see large scale diversification as a possible means of adding to the capacity of the existing component manufacturing section of the building industry. It seems likely that this could only come about as a result of an increased demand for building components.

Housing

99. One problem to be overcome in the housing programme is the varying requirements of the large number of local authorities responsible. We understand that steps are being taken to encourage housing authorities to form further consortia in order to pool their demands and to co-ordinate and standardise their technical requirements. Authorities forming consortia in shipbuilding areas might have a special interest in relating their work to the potential production of shipyards so as to alleviate the local unemployment problem. Such additional bodies as the Scottish Special Housing Association and the development corporations of New Towns might also be able to give special attention to the shipyards.

100. The necessary professional and technical expertise might be found by expanding existing resources or by forming new development groups. These we visualise as being in each case a team of architects, engineers, quantity surveyors and administrators, possibly together with sociologists and housing managers, who would be engaged collectively on the design of suitable constructional systems and components, in relation to suitably large and long term programmes. They could invite the collaboration of shipyards in the design of components and systems of construction specifically developed to exploit as fully as possible the existing productive capacity of the shipbuilding industry. Such collaboration would minimise

the problems of design, price level and marketing which face any yard wishing to diversify in this direction and which appear to have been the cause of past failures.

Other Building Types

101. If other building types such as schools, hospitals and universities are to contribute to this, co-ordination of demand would be necessary in these fields also. A number of consortia are already being established along the lines of the Consortium of Local Authorities Special Programme for school building, and we suggest that the development teams concerned be encouraged to examine the shipbuilding industry as a possible source of components.

102. We also suggest that there is room in university and hospital building for the development on a larger scale of standard components and structural systems. We understand that a start has already been made with the development of fitted furniture, door assemblies, and certain other components for hospital building so as to achieve a limited range of standard items which are to be the basis of bulk orders for high quality joinery, for which shipyards could tender in common with other suppliers.

CONCLUSIONS

103. From our rapid survey, it is clear that the shipyards can offer spare capacity which is suitable for the manufacture of components or complete systems of industrialised building. They represent the concentration of a wide variety of highly developed skills, and of a large productive capacity suitable for this purpose.

104. Some diversification into the manufacture of conventional products for the building industry could be immediate, but we believe that this could only be on a minor scale, because yards would be entering markets which are already highly competitive.

105. If industrialised building is to be introduced into this country on a large scale, especially for the housing programme, then the considerable amount of factory space at present available in shipyards represents an asset to the nation which could be harnessed for this purpose, rather than allowed to go to waste, or be duplicated by the setting up of new factories. In this respect we have made a notional estimate that if five per cent. of the existing covered production space in shipyards were turned over to the manufacture of industrialised building, it could provide components to make some 30,000 dwellings a year, or components to make an equivalent quantity of other building.

106. We suggest that the best method for large-scale diversification into the building field lies in the co-ordination of building into large-scale programmes, especially in the housing sector. Development teams could invite the collaboration of shipyards in the design and production of components and systems of construction for use in such programmes.

107. We understand that the Government is taking the initiative in encouraging further local authorities to pool their programmes for housing, schools and other building types, and, where appropriate, to set up development teams. Authorities in shipbuilding areas might have a special interest in doing so, if one of the objectives was to provide alternative outlets for the yards.

108. The managements of yards which we have visited are clearly enthusiastic for such diversification, but need technical guidance from the building industry, and we suggest that such development teams would be the best means of providing this.

109. The best form of industrialised building is likely to be lightweight prefabrication, since this would probably involve less capital investment and could be brought into production more quickly than heavyweight prefabrication. This would especially be the case if components or systems of construction could be developed specifically to exploit the existing productive capacity of shipyards. A further advantage of lightweight elements would be that they could be transported more cheaply to sites outside the shipbuilding areas.

110. Such measures, if they lead to a more widespread use of industrialised building methods, might not only help in providing permanent diversification for shipyards but could contribute to increasing the capacity of the building industry and to improving standards of quality.

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